BNL-63554

PHASE TRANSFORMATIONS IN ATMOSPHERIC AEROSOLS

J. Xu and D. G. Imre

American Geophysical Union 1996 Fall Meeting, San Francisco, CA, Dec. 15-19, 1996.

Atmospheric aerosols have a direct effect on the earth's radiative balance by scattering as much as 5% ($15Wm^{-2}$) of the solar radiation back to space, and an indirect one by determining cloud optical properties and frequency. To be able to properly incorporate these processes into GCMs requires a knowledge of aerosol microphysical properties, one of the most fundamental of which is their phase. We present experimental observations of phase transformations of single isolated atmospheric aerosols at temperatures from 300 to 180K.

The atmospheric conditions required for Cirrus clouds formation are determined by the conditions that induce freezing of sulfuric acid aerosols. Using a low temperature single particle levitation cell we were able to observe freezing of H_2SO_4/water aerosols. On the basis of these results we have generated a freezing line, which defines the combination of atmospheric conditions - temperature and water vapor pressure - that induce freezing. Such a line can directly be incorporated into GCMs to predict Cirrus cloud formation.

At lower altitudes the important phase transitions are deliquescence and efflorescence of hygroscopic particles. While much attention has been paid to the former, the reverse transition from liquid to solid, which atmospherically is just as important, has been ignored. Based on our experiments we have derived predictive efflorescence lines for a variety of atmospheric aerosols.

Recent results on the atmospherically important aerosol, NH_4HSO_4 will also be presented. Prior to the present work our knowledge the ammoniumbisulfate/water system was limited to a single point of the phase diagram. We have been able to map out the entire phase diagram for this atmospheric aerosol. In the process, we discovered an anhydrous metastable phase at room temperature and a new low temperature crystalline octahydrate phase.

Research by BNL investigators was performed under the auspices of the U.S. Department of Energy under Contract No. DE-AC02-98CH10886.